CLAIMS

1. A cross-copolymerized olefin/aromatic vinyl compound/diene copolymer characterized in that it is obtained by cross-copolymerizing an olefin/aromatic vinyl compound/diene copolymer having an aromatic vinyl compound content of from 0.03 mol% to 96 mol%, a diene content of from 0.0001 mol% to 3 mol% and the rest being an olefin, with an olefin/aromatic vinyl compound copolymer (which may contain a diene) having an aromatic vinyl compound content which is different by at least 5 mol%.

2. A cross-copolymerized olefin/aromatic vinyl compound/diene copolymer characterized in that it is obtained by using an olefin/aromatic vinyl compound/diene copolymer having an aromatic vinyl compound content of from 0.03 mol% to 96 mol%, a diene content of from 0.0001 mol% to 3 mol% and the rest being an olefin, and cross-copolymerizing it, wherein the aromatic vinyl compound content is different by at least 2 mol% as compared with the olefin/aromatic vinyl compound/diene copolymer prior to the cross-copolymerization.

3. The cross-copolymerized olefin/aromatic vinyl compound/diene copolymer according to Claim 2, characterized in that it has an aromatic vinyl compound content of from 5 mol% to 50 mol%, a diene content of from 0.0001 mol% to 3 mol% and the rest being ethylene or at least two types of olefins including ethylene, and it

has a crystal structure derived from an ethylene chain structure, wherein the aromatic vinyl compound content and at least one of the melting point such that the heat of crystal fusion as measured by DSC is at least 10J/g and at most 150 J/g, satisfies the following relation:

$(5 \leqq St \leqq 15)$

$-3 \cdot St + 125 \leqq Tm \leqq 140$

$(15 < St \leqq 50)$

$80 < Tm \leqq 140$

where Tm is the melting point (°C) such that the heat of crystal fusion is at least 10J/g and at most 150 J/g, and St is the aromatic vinyl compound content (mol%).

4. A process for producing a cross-polymerized olefin/aromatic vinyl compound/diene copolymer, characterized in that the production is carried out by employing a polymerization process of at least two steps comprising, as a first polymerization step (main chain polymerization step), carrying out copolymerization of an aromatic vinyl compound monomer, an olefin monomer and a diene monomer by means of a coordination polymerization catalyst to synthesize an olefin/aromatic vinyl compound/diene copolymer, and then, as a second polymerization step (crossing step) under conditions different therefrom, carrying out polymerization in the coexistence of this olefin/aromatic vinyl compound/diene copolymer and at least an olefin and an aromatic vinyl compound monomer by means of a coordination

polymerization catalyst.

5. The process according to Claim 4, wherein the amount of the diene used in the first polymerization step is from 1/50000 to 1/100 (molar ratio) of the amount of the aromatic vinyl compound monomer.

6. The process according to Claim 4, wherein the polymerization solution obtained by the first polymerization step is used for a polymerization step of the second or subsequent polymerization step without separation and recovery of the olefin/aromatic vinyl compound/diene copolymer.

7. A cross-copolymerized olefin/aromatic compound/diene copolymer having an aromatic vinyl compound content of from 0.03 mol% to 96 mol%, a diene content of from 0.0001 mol% to 3 mol% and the rest being an olefin, obtained by the process as defined in Claim 4.

8. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, characterized in that the olefin is ethylene or at least two types of olefins including ethylene.

9. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, characterized in that the aromatic vinyl compound is styrene.

10. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, characterized in that the diene is at least one of o-

divinylbenzene, p-divinylbenzene and m-divinylbenzene.

11. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, wherein the diene is m-divinylbenzene having an isomer purity of at least 80 weight%.

12. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, characterized in that MFR as measured under a load of 5 kg at 200°C is at least 0.02 g/10 min. and at most 100 g/10 min., or MFR as measured under a load of 5 kg at 230 °C is at least 1.0 g/min. and at most 50 g/10 min.

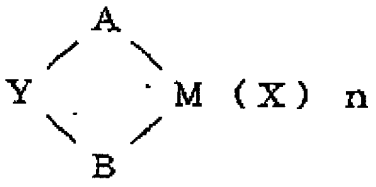
13. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, characterized in that the gel content is less than 10 weight%.

14. The cross-copolymerized olefin/aromatic compound/diene copolymer according to Claim 2 or 7, characterized in that in a molded product of 1 mm in thickness, it has a total light transmittance of at least 75% and/or a haze of at most 30%.

15. The process according to Claim 4, characterized in that the coordination polymerization catalyst to be used in the first polymerization step and the second polymerization step is a single site coordination polymerization catalyst.

16. The process according to Claim 4, characterized in that the coordination polymerization catalyst to be used

in the first polymerization step and the second polymerization step is a single site coordination polymerization catalyst comprising a transition metal compound represented by the following general formula (1) and a cocatalyst:



General formula (1)

wherein A and B are independently a group selected from an unsubstituted or substituted benzoindenyl group, an unsubstituted or substituted cyclopentadienyl group, an unsubstituted or substituted indenyl group, or an unsubstituted or substituted fluorenyl group;

Y is a methylene group, a silylene group, an ethylene group, a germilene group or a boron residue, which has bonds to A and B and which further has hydrogen or a group containing a C_{1-20} hydrocarbon (this group may have from 1 to 3 nitrogen, boron, silicon, phosphorus, selenium, oxygen or sulfur atoms), as a substituent, the substituents may be the same or different from one another, and Y may have a cyclic structure such as a cyclohexylidene group or a cyclopentylidene group;

each X is independently hydrogen, a halogen, a C_{1-15} alkyl group, a C_{6-10} aryl group, a C_{8-12} alkylaryl group, a silyl group having a C_{1-4} hydrocarbon substituent, a C_{1-10}

alkoxy group, or an amide group having hydrogen or a C_{1-22} hydrocarbon substituent, and n is an integer of 0, 1 or 2; and

M is zirconium, hafnium or titanium.

17. The process according to Claim 16, characterized in that at least one of A and B in the general formula (1) is an unsubstituted or substituted benzoindenyl group, or an unsubstituted or substituted indenyl group.

18. A molded product obtained by molding the cross-copolymerized olefin/aromatic vinyl compound/diene copolymer as defined in Claim 2 or 7.

19. A film made of the cross-copolymerized olefin/aromatic vinyl compound/diene copolymer as defined in Claim 2 or 7.

20. A composition characterized in that it contains from 1 to 99 weight% of the cross-copolymerized olefin/aromatic vinyl compound/diene copolymer as defined in Claim 2 or 7.

21. A molded product obtained by molding a composition which contains from 1 to 99 weight% of the cross-copolymerized olefin/aromatic vinyl compound/diene copolymer as defined in Claim 2 or 7.

22. A composition comprising the cross-copolymerized olefin/aromatic vinyl compound/diene copolymer as defined in Claim 2 or 7, and a polyolefin, and/or a plasticizer.

23. An olefin/aromatic vinyl compound/divinylbenzene copolymer having an aromatic vinyl compound content of

from 0 mol% to 96 mol%, a diene content of from 0.0001 mol% to 3 mol% and the rest being an olefin, obtained by copolymerizing m-divinylbenzene having an isomer purity of at least 80 weight%, an olefin and an aromatic vinyl compound.